

# **Cold reduced tinmill products — Electrolytic tinplate and electrolytic chromium/ chromium oxide coated steel**

The European Standard EN 10202:2001 has the status of a  
British Standard

ICS 77.140.50

## National foreword

This British Standard is the official English language version of EN 10202:2001. It supersedes BS EN 10202:1990 and BS EN 10203:1991 which are withdrawn.

The UK participation in its preparation was entrusted to Technical Committee ISE/29, Tinplate and blackplate, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

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## Cold reduced tinmill products — Electrolytic tinplate and electrolytic chromium/chromium oxide coated steel

Aciers pour emballage laminés à froid — Fer blanc  
électrolytique et fer chromé électrolytique

Kaltgewalzte Verpackungsblecherzeugnisse —  
Elektrolytisch verzinneter und spezialverchromter Stahl

This European Standard was approved by CEN on 4 February 2001.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Management Centre has the same status as the official versions.

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## Foreword

This European Standard has been prepared by Technical Committee ECISS/TC 26, Tinmill products — Qualities, dimensions, tolerances and specific tests, the Secretariat of which is held by BSI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by September 2001, and conflicting national standards shall be withdrawn at the latest by September 2001.

This European Standard replaces EN 10202:1989.

This European Standard revises and combines EN 10202:1989, *Cold reduced electrolytic chromium/chromium oxide coated steel*, and EN 10203:1991, *Cold reduced electrolytic tinplate*. EN 10203 is withdrawn.

It is intended that the third European Standard in the present series, EN 10205:1992, *Cold reduced blackplate in coil form for the production of tinplate or electrolytic chromium/chromium oxide coated steel*, will be withdrawn.

COCOR (Coordinating Commission of ECISS) approved the work item to revise EN 10202:1989 at its meeting in November 1996. The following countries agreed to participate: Belgium, France, Germany, Italy, Netherlands, Norway and the United Kingdom.

The annexes A, F, G, H and I are informative; the annexes B, C, D and E are normative. This European Standard also contains a Bibliography.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

## 1 Scope

This European Standard specifies requirements for tinmill products in the form of sheets or coils for subsequent cutting into sheets. Tinmill products consist of single and double reduced low carbon mild steel electrolytically coated with either tin (tinplate) or chromium/chromium oxide (ECCS).

Single reduced tinmill products are specified in nominal thicknesses that are multiples of 0,005 mm from 0,17 mm up to and including 0,49 mm. Double reduced tinmill products are specified in nominal thicknesses that are multiples of 0,005 mm from 0,13 mm up to and including 0,29 mm.

This European Standard applies to coils and sheets cut from coils in nominal minimum widths of 600 mm.

NOTE Standard width coils for specific uses, e.g. tabstock, may be slit into narrow strip for supply in coil form.

## 2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate points in the text and the publications are listed hereafter. Subsequent amendments to, or revisions of, any of these publications apply to this European Standard only when incorporated in it by amendment or revision. In the case of undated references, the most recent edition of the publications referred to applies (including amendments).

EN 610:1996, *Tin and tin alloys — Ingot tin*

EN 10002-1:1989, *Metallic materials — Tensile testing — Part 1: Methods of test (at ambient temperature)*

EN 10109-1:1996, *Metallic materials — Hardness test — Part 1: Rockwell test (scales A, B, C, D, E, F, G, H, K) and Rockwell superficial test (scales 15N, 30N, 45N, 15T, 30T and 45T)*

EN ISO 4288, *Geometrical product specifications (GPS) — Surface texture: Profile method — Rules and procedures for the assessment of surface texture (ISO 4288 :1996)*

## 3 Terms and definitions

For the purposes of this standard the following terms and definitions apply:

### 3.1

#### **electrolytic tinplate**

cold rolled low carbon mild steel sheet or coil coated on both surfaces with tin that is applied in continuous electrolytic operation

### 3.2

#### **differentially coated electrolytic tinplate**

electrolytic tinplate, one surface of which carries a heavier tin coating than the other. In some cases one surface may have no tin coating

### 3.3

#### **electrolytic chromium/chromium oxide coated steel (ECCS)**

cold rolled low carbon mild steel sheet or coil electrolytically treated to produce on both surfaces a duplex film of metallic chromium adjacent to the steel substrate with a top layer of hydrated chromium oxides or hydroxides

### 3.4

#### **single cold reduced**

term used to describe those products where the steel substrate has been reduced to the desired thickness in a cold reduction mill and subsequently annealed and temper rolled

### 3.5

#### **double cold reduced**

term used to describe those products in which the steel substrate, after annealing, has had a second reduction in excess of 5 %, using a lubricant

### 3.6

#### **temper rolling**

secondary rolling process, in which the reduction is less than or equal to 5 %, normally carried out dry

### 3.7

#### **standard grade**

material in sheet form that, having passed line inspection, is suitable under normal conditions of storage, for established lacquering and printing over the entire surface of the sheet and does not contain any defect that renders the material unsuitable for its intended use (see line inspection 3.25)

**3.8****second grade**

material that represents the best sheets rejected from the standard grade but may contain sheets exhibiting defects in surface appearance and shape of limited extent. Suitability for established lacquering and printing over the entire surface of the sheet is not assured. Not normally available in ECCS

**3.9****batch (box) annealed (BA)**

process in which the cold reduced strip is heated in tight coil form, within a controlled atmosphere, for a pre-determined time/temperature cycle

**3.10****continuously annealed (CA)**

process in which cold reduced coils are unwound and heated in strip form within a controlled atmosphere for a pre-determined time/temperature cycle

**3.11****finish**

surface appearance of tinmill products is determined by the surface characteristics of the steel base together with the condition of the coating which, in the case of tinplate, can be either flow-melted or unflow-melted

**3.11.1****flow-melting**

process by which the 'as deposited' tin is heated above its melting point of 232 °C and is quickly quenched in cool water resulting in a composite coating iron/tin alloy and free tin which exhibits a bright reflective appearance

**3.11.2****bright finish**

finish resulting from the use of temper mill work rolls that have been ground to a high degree of polish and, in the case of tinplate, together with a flow-melted tin coating

**3.11.3****stone/fine stone finishes**

finishes characterized by a directional pattern, resulting from the use of final mill work rolls that have been ground to a lower degree of polish than those used for the bright finish, in the case of tinplate together with a flow-melted tin coating

**3.11.4****shot blast**

finish resulting from the use of temper mill work rolls that have been shot blasted

**3.11.5****silver finish**

tinplate product resulting from the use of shot blasted temper mill work rolls and with a flow-melted tin coating

**3.11.6****matt finish**

tinplate product resulting from the use of shot blasted temper mill work rolls and with an unflow-melted tin coating

**3.12****coil**

rolled flat strip product which is wound into regularly superimposed laps so as to form a coil with almost flat sides

**3.13****bow**

residual curvature in sheet or coil such that the distance between the edges is less than the appropriate sheet or coil dimension

**3.13.1****longitudinal (line) bow**

residual curvature in the strip remaining along the direction of rolling

**3.13.2****transverse (cross) bow**

mode of curvature in the sheet such that the distances between its edges parallel to the rolling direction is less than the sheet width

**3.14****centre fullness (full centre, centre buckle)**

intermittent vertical displacement occurring other than at the edge of the sheet or coil when the material is laid on a flat horizontal surface

**3.15****short pitch camber**

deviation of the coil from a straight line forming its chord

**3.16****edge wave**

intermittent vertical displacement occurring at the edge of a sheet or a sample from a coil when laid on a flat horizontal surface

**3.17****feather edge (transverse thickness profile)**

variation in thickness, characterized by a reduction of thickness close to the edges, at right angles to the rolling direction

**3.18****burr**

metal displaced beyond the plane of the surface of the strip by shearing action

**3.19****rolling width**

width of the strip perpendicular to the rolling direction

**3.20****consignment**

quantity of material of the same specification made available for despatch at the same time

**3.21****bulk package, or bulk**

packaging unit comprising a stillage platform, the sheets and packaging material

**3.22****stillage platform**

platform on which sheets are stacked to facilitate packing and ready transportation

**3.23****skid**

base platform on which a coil is placed to facilitate ready transportation

**3.24****sample unit**

750 m of coil cut into sheets, for the purposes of sampling

**3.25****line inspection**

final inspection of the finished product performed by instruments and/or by visual examination at normal production line speeds

**3.26****anvil effect**

effect which a hard anvil can produce on the numerical hardness value obtained when a hardness test is performed on very thin sheet supported on such an anvil

**3.27****S.I.T.A.**

area of 100 m<sup>2</sup> of material (a total surface area of 200 m<sup>2</sup>)

## **4 Information to be supplied by the purchaser**

### **4.1 General**

The following information shall be given on the enquiry and order to assist the manufacturer in supplying the correct material:

- a) the designation as given in clause 5;
- b) the quantity expressed as an area (S.I.T.A.'s) or mass (tonnes);
- c) the maximum and minimum mass and/or outside diameter of coils;
- d) marking requirements for differentially coated tinplate (see clause 11);
- e) any further special requirements e.g. special surface property requirements for packaging white or citrus fruits;
- f) the type of annealing i.e. BA or CA.

**NOTE** Appropriate grades are suitable for shaping operations such as stamping, drawing, folding, beading, bending and assembly work such as joint forming, soldering and welding. The end use should be borne in mind when the grade is selected.

### **4.2 Delivery conditions**

The product shall be supplied on the following basis, unless the purchaser specifies otherwise on the enquiry and order:

- a) in the case of tinplate with cathodic surface passivation treatment using a dichromate salt of an alkali metal (see 6.3);
- b) where differential tin coatings are ordered the heavier coated surface shall be indicated by continuous parallel lines spaced at 75 mm intervals (see clause 11);
- c) for double reduced tinmill products: with a stone surface finish (see note 1 to Table 1);
- d) for coils: the location of each weld shall be indicated by a piece of non-rigid material and a punched hole (see 10.3);
- e) for coils, the coils shall be dispatched with their cores vertical (see 14.1.1);
- f) for sheets: the direction of the runners of the stillage platform is at the discretion of the producer but shall be consistent within a consignment (see 14.2);
- g) for sheets: the rolling width shall be either of the two specified dimensions (see 4.3);
- h) in the case of tinplate with a coating of DOS (see 6.4) or in the case of ECCS with a coating of either DOS or BSO.

### 4.3 Additional information

In addition to the information in 4.1 and 4.2 the purchaser shall provide further information to the supplier to ensure that the order requirements are consistent with the end use of the product.

The purchaser shall inform the supplier of any modifications to his fabrication operations that will significantly affect the way in which the tinmill products are used.

**NOTE 1** It should be noted that double cold reduced tinmill products are relatively less ductile than single cold reduced products and have very distinct directional properties, so for some uses, e.g. for three-piece can bodies, the direction of rolling should be stated.

**NOTE 2** When double cold reduced products are used for three-piece can bodies, the rolling direction should be around the circumference of the can so as to minimize the hazard of flange cracking.

## 5 Designation

For the purposes of this European Standard, tinmill products are classified based on tensile properties as given in Table 4.

Single and double reduced products covered by this European Standard shall be designated by the following characteristics in the sequence given:

- a) a description of the material (either tinplate coil or sheet or ECCS coil or sheet);
- b) the number of this European Standard (EN 10202);
- c) the symbol for tinmill products (T);
- d) the mechanical property grade (see Table 4);
- e) the type of annealing (see 8.1.3);
- f) the type of finish (see 6.2);
- g) in the case of tinplate, the coating masses and their combinations, E (for equally coated) or D (for differentially coated) described in clause 11; in the case of ECCS coil or sheet, the letters ECCS;
- h) in the case of tinplate, the coating tolerance (see Table 2);
- i) in the case of tinplate, the passivation (see 6.3);
- j) the dimensions in mm:
  - for coils: thickness × rolling width;
  - for sheets: thickness × rolling width × cut length.

**Example:** single cold reduced tinplate sheet in accordance with this European Standard of steel grade S275, batch annealed, stone finish, equally coated with a coating mass of  $2,8 \text{ g/m}^2$  for high speed welding, passivation 300 with a thickness of 0,22 mm, a rolling width of 800 mm and cut length of 900 mm shall be designated:

tinplate sheet EN 10202-TS275-BA-ST-E2,8/2,8-HS-300-0,22×800×900

or double cold reduced tinplate coil in accordance with this European Standard, of steel grade H620, continuously annealed, stone finish, differentially coated with coating masses of  $8,4 \text{ g/m}^2$  and  $5,6 \text{ g/m}^2$  for standard use, passivation 311 with a thickness of 0,18 mm and a rolling width of 750 mm shall be designated:

tinplate coil EN 10202-TH620-CA-ST-D8,4/5, 6-SP-311-0,18×750

or double cold reduced ECCS coil in accordance with this European Standard, of steel grade H620, continuously annealed, fine stone finish, with a thickness of 0,185 mm and a rolling width of 750 mm shall be designated:

ECCS coil EN 10202-TH620-CA-FS-ECCS-0,185×750

**NOTE** The designation does not cover variations in all material properties. Further detailed product definition may be required.

## 6 Manufacturing features

### 6.1 Manufacture

For tinplate the purity of tin used to produce the coating shall be not less than 99,85 % (see EN 610).

The methods of manufacture of tinmill products are the responsibility of the manufacturer and are not specified in this European Standard.

The purchaser shall be informed if any alteration is made to the method of manufacture that will affect the properties of the product.

The manufacturer shall supply to the purchaser details of the manufacturing process to ensure efficient use of the product by the purchaser.

**NOTE** Information on the types and chemical composition of steels for tinmill products is provided in annex A.

### 6.2 Finish

The recognized finishes of tinmill products including surface roughness of the steel base, shall be as in Table 1.

**Table 1 — Recognized finishes**

| Product finish | Code | Steel base | Tinplate/ECCS | Flow-melted | Nominal surface roughness of the steel base<br>$\mu\text{m Ra}$ |
|----------------|------|------------|---------------|-------------|-----------------------------------------------------------------|
| Bright         | BR   | Smooth     | TPL           | Yes         | $\leq 0,35$                                                     |
| Fine stone     | FS   | Fine stone | TPL           | Yes         | 0,25 – 0,45                                                     |
| Fine stone     | FS   | Fine stone | ECCS          | -           | 0,25 – 0,45                                                     |
| Stone          | ST   | Stone      | TPL           | Yes         | 0,35 – 0,60                                                     |
| Stone          | ST   | Stone      | ECCS          | -           | 0,35 – 0,60                                                     |
| Silver         | SG   | Shot blast | TPL           | Yes         | $\geq 0,90$                                                     |
| Matt           | MM   | Shot blast | TPL           | No          | Various                                                         |

NOTE 1 Double reduced product is only supplied as stone finish.

NOTE 2 For guidance on the measurement of surface roughness, refer to EN ISO 4288.

NOTE 3 The appearance is governed by:

- the surface characteristics of the steel base which principally result from controlled preparation of the work rolls used during the final stages of temper rolling;
- the mass of the coating applied;
- whether the tin layer is flow-melted or unflow-melted.

NOTE 4 For de-tinning prior to testing for surface roughness, see annex B.

### 6.3 Passivation

Under normal conditions of transport and storage, tinmill products shall be suitable for surface treatments such as established lacquering and printing operations.

ECCS is not subject to a passivation treatment.

After tinning, tinplate is subject to a passivation treatment in which chromium and chromium oxides are deposited on to each surface to improve resistance to oxidation and improve suitability for lacquering and printing. There are two tinplate passivation processes in common use:

- Code 311, which is the most widely used and is a process of cathodic treatment in a solution of sodium dichromate;
- Code 300, which is a simple chemical dip treatment in a sodium dichromate solution.

Code 311 will normally be supplied unless otherwise specified.

Values per surface for total chromium shall be as follows:

|          |                            |
|----------|----------------------------|
| Code 311 | 3,5 to 9,0 $\text{mg/m}^2$ |
| Code 300 | 1,0 to 3,0 $\text{mg/m}^2$ |

The preferred method of measurement is the diphenylcarbazide method (see annex C).

## 6.4 Oiling

Tinmill products, coils and sheets, shall be supplied with an oil coating. The oil shall be recognized (i.e. by the relevant national or international authority) as suitable for food packaging. Unless otherwise agreed at the time of order (see 4.2 h)) the oils used shall be dioctyl sebacate (DOS) for tinplate and either DOS or butyl stearate oil (BSO) for ECCS.

Oil shall be applied uniformly across the surface in quantities which, where applicable, are compatible with lacquering, printing and handling operations and cause no de-wetting or excessive dust pick up.

## 7 Coatings

### 7.1 Electrolytic tinplate

#### 7.1.1 Properties

Values for tin coatings for single surfaces shall be as shown in Table 2. The values shown shall apply to single spot measurements.

**NOTE** Guidance on the marking and identification of differentially coated tinplate is provided in clause 11.

The mass per unit area for equally and differentially coated tinplate shall be determined on test pieces taken from samples selected in accordance with clause 12 and tested in accordance with 7.1.2. In cases of dispute the referee method given in annex D shall be used.

**Table 2 — Single spot values for tin coatings**

| Nominal coating<br>g/m <sup>2</sup> | High speed welding applications <sup>1)</sup><br>(HS) |                             | Other applications<br>(SP) |                             |
|-------------------------------------|-------------------------------------------------------|-----------------------------|----------------------------|-----------------------------|
|                                     | g/m <sup>2</sup><br>min                               | g/m <sup>2</sup><br>max     | g/m <sup>2</sup><br>min    | g/m <sup>2</sup><br>max     |
| 1,00                                | 0,75                                                  | 1,80                        | 0,75                       | No technical<br>requirement |
| 1,40                                | 1,10                                                  | 2,30                        | 1,10                       |                             |
| 2,00                                | 1,60                                                  | 3,00                        | 1,60                       |                             |
| 2,80                                | 2,30                                                  | 3,90                        | 2,30                       |                             |
| 4,00                                | 3,35                                                  | 5,30                        | 3,35                       |                             |
| 5,00                                | 4,20                                                  | 6,50                        | 4,20                       |                             |
| 5,60                                | 4,70                                                  | 7,20                        | 4,70                       |                             |
| 8,40                                | 7,15                                                  |                             | 7,15                       |                             |
| 11,20                               | 9,55                                                  | No technical<br>requirement | 9,55                       |                             |
| 14,00                               | 11,95                                                 |                             | 11,95                      |                             |
| 15,10                               | 12,90                                                 |                             | 12,90                      |                             |

<sup>1)</sup> Continuous electrical resistance welding at speeds greater than 30 m/min.

## 7.1.2 Test method

### 7.1.2.1 Test pieces

From each sheet selected in accordance with clause 12, two test pieces (one per surface), each of an accurately determined area not less than 2 500 mm<sup>2</sup>, and preferably in the form of discs, shall be carefully prepared. The test pieces shall be taken not less than 25 mm from the edges.

### 7.1.2.2 Method of determination

The tin coating mass shall be expressed in grams of tin per square metre to the nearest 0,1 g/m<sup>2</sup>.

For routine quality control purposes the coating masses may be determined by any of the recognized and acceptable analytical methods but, in case of dispute and for all retests, the method described in annex D shall be the referee method.

The tin coating mass of a consignment shall be taken as the average of all the results.

## 7.2 ECCS

### 7.2.1 General

ECCS shall be lacquered on both surfaces before use.

NOTE ECCS is not suitable for soldering or welding.

Total chromium and chromium in oxide coating masses shall be as in Table 3 and the values shown shall apply to the average of three single spot measurements.

The mass per unit area shall be determined on test pieces taken from samples selected in accordance with clause 12 and tested in accordance with clause 7.2.2.

**Table 3 — ECCS masses**

|                                                                                                            | Coating mass (mg/m <sup>2</sup> ) each surface |     |
|------------------------------------------------------------------------------------------------------------|------------------------------------------------|-----|
|                                                                                                            | Min                                            | Max |
| Total chromium                                                                                             | 50                                             | 140 |
| Chromium in oxides                                                                                         | 7                                              | 35  |
| NOTE Total chromium is the sum of the metallic chromium and chromium content of the oxides and hydroxides. |                                                |     |

### 7.2.2 Test method

#### 7.2.2.1 Test pieces

From each sheet selected in accordance with clause 12, four discs, each of area not less than 2 500 mm<sup>2</sup>, shall be taken from each of the three sets of positions. The test area of each disc shall be of an accurately determined area not less than 2 000 mm<sup>2</sup>. The edge test pieces shall be taken not less than 25 mm from the edges.

Two of the four discs (two per surface) from each position shall be used for the separate determinations of the masses of chromium in the metallic chromium layer and the chromium oxide layer on one surface of the sheet and the other two discs shall be used for the corresponding determinations on the other surface.

### 7.2.2.2 Method of determination

The masses of metallic chromium and chromium in oxide shall be expressed in milligrams per square metre to the nearest 1 mg/m<sup>2</sup>.

For routine test purposes the coating masses may be determined by any of the recognized and acceptable analytical methods but, in cases of dispute and for all retests, the method described in annex E shall be the referee method.

Any tests carried out using the test in annex E shall be performed on untreated material, in the as produced state.

## 8 Mechanical properties

### 8.1 Classification

#### 8.1.1 General

A number of different mechanical properties may be determined for tinmill products.

No single mechanical test can measure all the factors which may affect their fabrication characteristics, nor is it possible to apply any single test satisfactorily to the range of tinmill products currently produced.

Individual mechanical properties can significantly influence the performance of tinplate in processing and subsequent intended use and will vary depending on the steel type and the methods of casting, annealing and temper rolling employed.

**NOTE 1** The term "temper" when applied to tinmill products, summarizes a combination of interrelated properties.

The test considered to provide the best guide to mechanical properties is the tensile test which measures yield or proof strength and tensile strength. For the purpose of this European Standard these tests form the basis of the classification shown in Table 4. In cases of dispute, the tensile test shall be the referee method.

**NOTE 2** The tensile test is a laboratory test which is not always available to users. Tests which are suitable for in plant evaluation of tinmill products are the Rockwell hardness test (see annex F) and Springback test (see annex G). The Rockwell hardness test is suitable for use with SR materials and the Springback test for DR. The Rockwell hardness test should be used as a means of fault diagnosis for DR material only in the absence of suitable samples and equipment for the preferred tests.

**NOTE 3** Samples used for Rockwell hardness testing shall be de-tinned and for CA products, adequately aged. Artificial ageing will normally be necessary where the material has not been pre-stoved through a lacquering or printing process and this can be achieved by heating the specimen to 200 °C for 20 minutes.

#### 8.1.2 Test method for tensile properties

##### 8.1.2.1 Test pieces

For each sheet selected in accordance with clause 12, cut two rectangular test pieces approximately 200 mm × 25 mm wide, with the rolling direction parallel to the length of the test piece, at the position marked Z in Figure 1. Ensure that the edge test pieces clear the edges of the sheet by a minimum of 25 mm. Before carrying out the tensile test, artificially age the test pieces at 200 °C for 20 minutes.